

WHAT IS CLAIMED IS:

1. A complex functional apparatus comprising a haptic information element having haptic information portions corresponding to a plurality of different  
5 kinds of haptic information,

each haptic information unit including:

a first function unit configured to detect corresponding haptic information; and

a second function unit configured to reproduce  
10 some or all pieces of detected haptic information.

2. The apparatus according to claim 1, wherein each haptic information unit has a plurality of electrode pairs,

the first function unit obtains detection signals  
15 of the haptic information via the electrode pairs, and

the second function unit reproduces some or all pieces of haptic information by converting the haptic information into physical quantities which are the same as or different from the detection signals by inputting  
20 electric power from an external power supply to the electrode pairs.

3. The apparatus according to claim 2, wherein the electrode pairs are formed via a metal oxide film, and the metal oxide film detects the detection  
25 signals.

4. The apparatus according to claim 3, wherein the metal oxide film is formed of a ferroelectric or

pyroelectric.

5. The apparatus according to claim 1, wherein the plurality of different kinds of haptic information include a temperature and pressure.

5 6. The apparatus according to claim 5, wherein at least the haptic information unit which corresponds to a pressure as the haptic information is formed on a cantilever-shaped elastic member.

7. The apparatus according to claim 5, wherein the  
10 haptic information unit which corresponds to a pressure as the haptic information detects a frequency and amplitude of a pressure acting on that portion, and is mechanically displaced at a frequency and amplitude according to the detection signal or pre-set pressure  
15 information by the external power supply.

8. The apparatus according to claim 5, wherein said haptic information element comprises a plurality of stacked structures each of which has an electrode, metal oxide film, and electrode structure formed on a  
20 cantilever-shaped elastic member.

9. The apparatus according to claim 5, wherein said haptic information element comprises a plurality of stacked structures each of which has an electrode, metal oxide film, and electrode structure formed on a  
25 cantilever-shaped elastic member, and another stacked structure arranged around the elastic member.

10. The apparatus according to claim 8, wherein the

haptic information is detected based on an output from each stacked structure, and some or all detection signals are converted into physical quantities which are the same as or different from the detection signals  
5 by inputting electric power from the external power supply to that stacked structure so as to reproduce the haptic information.

11. The apparatus according to claim 8, wherein a plurality of cantilever-shaped elastic members are  
10 arranged in a rotation symmetry relationship.

12. The apparatus according to claim 1, wherein a plurality of haptic information elements equivalent to said haptic information element are linearly or two-dimensionally arranged.

15 13. A haptic information system comprising:  
a complex functional apparatus;  
an input controller configured to receive signals from respective haptic information elements;  
an arithmetic processor configured to store the  
20 signals and applying a signal process to the stored signals; and  
an output controller configured to read out the signals from said arithmetic processor and output the readout signals to said complex functional device,  
25 wherein said complex functional apparatus comprises haptic information elements each having haptic information units corresponding to a plurality

of different kinds of haptic information, and each haptic information unit includes a first function unit configured to detect corresponding haptic information, and a second function unit configured to reproduce some  
5 or all pieces of detected haptic information.

14. The system according to claim 13, further comprising a communication circuit for exchanging the signals with an external apparatus.

15. A complex functional apparatus comprising a  
10 substrate, a metal oxide layer formed on said substrate, and an electrode, wherein said apparatus detects a plurality of different kinds of information by electrodes formed on a plurality of portions obtained by dividing said metal oxide layer.

15 16. The apparatus according to claim 15, wherein said metal oxide layer divided into the plurality of portions forms one element, and elements equivalent to that element are arranged linearly or two-dimensionally.

17. The apparatus according to claim 15, wherein said  
20 metal oxide layer comprises a ferroelectric or pyroelectric, and the information to be detected is one of a pressure, temperature, acceleration, and angular acceleration.

18. The apparatus according to claim 17, wherein said  
25 ferroelectric or pyroelectric is formed by alternately stacking crystal planes formed of a metal - oxygen, and crystal planes formed of oxygen alone, or alternately

stacking crystal planes formed of a plurality of metals and oxygen.

19. The apparatus according to claim 15, wherein at least one portion of said metal oxide layer divided  
5 into the plurality of portions is formed on an elastic member attached to a hollow space structure.

20. The apparatus according to claim 19, wherein the portion that detects a temperature has the hollow space structure.

10 21. A complex functional apparatus comprising a detection device which comprises a substrate, a metal oxide layer formed on said substrate, and an electrode, detects a plurality of different kinds of information by electrodes arranged on a plurality of portions  
15 obtained by dividing said metal oxide film, and is stacked on a display configured to display video information.

22. The apparatus according to claim 21, wherein at least one portion of said metal oxide layer is formed  
20 on an elastic member attached to a hollow space structure.

23. The apparatus according to claim 22, wherein at least the portion that detects a pressure is attached to the elastic member attached to the hollow space  
25 structure.

24. The apparatus according to claim 21, wherein the electrodes of the portions that respectively detect a

temperature and pressure are transparent electrodes.

25. A method of manufacturing a complex functional apparatus which detects a plurality of different kinds of information by electrodes formed on a plurality of portions obtained by dividing a metal oxide film, comprising: forming the metal oxide layer by independently supplying a metal source material and oxygen source material which form the metal oxide layer to a substrate.
26. The method according to claim 25, wherein a metal and oxygen which form the metal oxide layer are supplied from independent supply devices to alternately stack crystal planes formed of the metal and oxygen and crystal planes formed of the oxygen.
27. The method according to claim 26, wherein a metal component source material supplied from the independent supply device is a material selected from the group consisting of a metal, metal oxide, organometallic compound, and metal halide, and an oxygen source gas is a material selected from the group consisting of oxygen, ozone, and nitrogen oxide.
28. The method according to claim 27, wherein at least one of a heating device, an ionization device, a plasma conversion device, and an acceleration electrode for accelerating a charge substance is attached to the metal source gas supply device, and the source gas is supplied while being d composed and/or accelerated by

the device attached.

29. The method according to claim 27, wherein at least one of a heating device, an ionization device, and a plasma generator is attached to the metal source gas supply device, and the source gas is supplied while  
5 being activated by the device attached.

30. An information input/output apparatus for controlling an operation of a target apparatus on the basis of a user authentication result associated with a  
10 user who operates the target apparatus, comprising:

a menu presentation unit configured to present a list of a plurality of menu items used to operate the target apparatus;

a haptic information acquisition unit acquire  
15 haptic information of the user on the basis of a position of the menu item that the user touches with a finger of the plurality of menu items presented by said menu presentation unit; and

a user authentication unit authenticate the user  
20 on the basis of the haptic information acquired by said haptic information acquisition unit.

31. The apparatus according to claim 30, further comprising a haptic information output unit configured to output haptic information in a state that allows the  
25 user to recognize information contents thereof upon user's touching the information with the finger at the position of each menu item presented by said menu

presentation unit.

32. An information input/output apparatus for  
outputting predetermined haptic information to a user,  
and inputting a user's reaction made for the output  
5 haptic information, comprising:

a haptic information output unit configured to  
output a plurality of menu items required for the user  
to operate a target apparatus as haptic information in  
a state that allows the user to recognize information  
10 contents thereof upon user's touching the information  
with a finger;

a haptic information input unit configured to  
acquire a user's fingerprint on the basis of a position  
of the menu item touched by the user of the plurality  
15 of menu items output by said haptic information output  
unit; and

user information processor configured to acquire  
a user's intention and authenticate the user on the  
basis of the user's fingerprint acquired by said haptic  
20 information input unit.

33. The apparatus according to claim 32, further  
comprising recognition result output unit configured to  
inform the user of at least one of information  
indicating whether or not the target apparatus has  
25 recognized the user's intention acquired by said user  
information processor, and authentication result  
information of the user by said user information



processor in a state that allows the user to recognize contents of the information upon user's touching the information with the finger.

34. The apparatus according to claim 31, wherein the  
5 haptic information output by said haptic information output unit is information perceived by the user as at least one physical quantity of a three-dimensional pattern, electricity, and calorific value at respective positions of the plurality of menu items.

10 35. The apparatus according to claim 30, wherein the user is authenticated on the basis of fingerprint information of the user, which is detected from a distribution of at least one physical quantity of a pressure and calorific value produced by the finger of  
15 the user.

36. The apparatus according to claim 31, further comprising image display configured to visually display predetermined image information, and wherein both the image information displayed on said image  
20 display , and the haptic information output by said haptic information output unit are presented to the user.

37. An information input/output method for controlling an operation of a target apparatus on the  
25 basis of a user authentication result associated with a user who operates the target apparatus, comprising:

a menu presentation step of presenting a list of

a plurality of menu items used to operate the target apparatus;

a fingerprint information acquisition step of acquiring fingerprint information of the user on the basis of a position of the menu item that the user touches with a finger of the plurality of menu items presented in the menu presentation step; and

a user authentication step of authenticating the user on the basis of the fingerprint information acquired in the fingerprint information acquisition step.

38. An information input/output method in an information input/output apparatus for outputting predetermined haptic information to a user, and inputting a user's reaction made for the output haptic information, comprising:

a haptic information output step of outputting a plurality of menu items required for the user to operate a target apparatus as haptic information in a state that allows the user to recognize information contents thereof upon user's touching the information with a finger;

a haptic information input step of acquiring a user's fingerprint on the basis of a position of the menu item touched by the user of the plurality of menu items output in the haptic information output step; and a user information processing step of acquiring a

user's intention and authenticating the user on the basis of the user's fingerprint acquired in the haptic information input step.

39. A computer program for implementing an  
5 information input/output method for controlling an operation of a target apparatus on the basis of a user authentication result associated with a user who operates the target apparatus, comprising:

a menu presentation step of presenting a list of  
10 a plurality of menu items used to operate the target apparatus;

a fingerprint information acquisition step of acquiring fingerprint information of the user on the basis of a position of the menu item that the user  
15 touches with a finger of the plurality of menu items presented in the menu presentation step; and

a user authentication step of authenticating the user on the basis of the fingerprint information acquired in the fingerprint information acquisition  
20 step.

40. A computer program for implementing an information input/output method in an information input/output apparatus for outputting predetermined haptic information to a user, and inputting a user's  
25 reaction made for the output haptic information, comprising:

a haptic information output step of outputting a

plurality of menu items required for the user to  
operate a target apparatus as haptic information in a  
state that allows the user to recognize information  
contents thereof upon user's touching the information  
5 with a finger;

a haptic information input step of acquiring a  
user's fingerprint on the basis of a position of the  
menu item touched by the user of the plurality of menu  
items output in the haptic information output step; and  
10 a user information processing step of acquiring a  
user's intention and authenticating the user on the  
basis of the user's fingerprint acquired in the haptic  
information input step.

41. A computer readable recording medium recording a  
15 program of claim 39.

42. An information input/output apparatus for  
controlling an operation of a target apparatus on the  
basis of a user authentication result associated with a  
user who operates the target apparatus, comprising:

20 a menu presentation unit configured to present a  
list of a plurality of menu items used to operate the  
target apparatus;

a haptic information acquisition unit configured  
to acquire haptic information of the user on the basis  
25 of a position of the menu item that the user touches  
with a finger of the plurality of menu items presented  
by said menu presentation means; and

a user authentication unit configured to authenticate the user on the basis of the haptic information acquired by said haptic information acquisition unit,

5            wherein said haptic information acquisition unit comprises a haptic information element having haptic information units corresponding to a plurality of different kinds of haptic information, and each haptic information unit includes a first function unit  
10 configured to detect corresponding haptic information, and a second function unit reproduce some or all pieces of detected haptic information.

43.    An information input/output apparatus for controlling an operation of a target apparatus on the  
15 basis of a user authentication result associated with a user who operates the target apparatus, comprising:

a menu presentation unit configured to present a list of a plurality of menu items used to operate the target apparatus;

20            a haptic information acquisition unit configured to acquire haptic information of the user on the basis of a position of the menu item that the user touches with a finger of the plurality of menu items presented by said menu presentation unit; and

25            a user authentication unit configured to authenticate the user on the basis of the haptic information acquired by said haptic information

acquisition unit,

wherein said haptic information acquisition unit comprises a substrate, a metal oxide layer formed on the substrate, and an electrode, and detects a  
5 plurality of different kinds of information by electrodes formed on a plurality of portions obtained by dividing the metal oxide layer.